



## TFT LCD Approval Specification

# MODEL NO.: N156B3

## Suffix:-L0B

Customer : \_\_\_\_\_ HP

Approved by : \_\_\_\_\_

Note :

| 核准時間                   | 部門          | 審核                                 | 角色       | 投票     |
|------------------------|-------------|------------------------------------|----------|--------|
| 2010-06-01<br>16:11:23 | NB<br>產品管理處 | <div>楊<br/>2010.06.01<br/>竣傑</div> | Director | Accept |



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**REVISION HISTORY**

| Version  | Date         | Page<br>(New) | Section | Description  |
|----------|--------------|---------------|---------|--|
| Ver. 1.0 | Jan.08, 2010 | All           | All     | Preliminary spec 1.0 was first issued for N156B3-L0B |
|          |              | 4             | 1.5     | Update module weight                                 |
|          |              | 7             | 3.1     | Update Power Supply Current and EBL                  |
|          |              | 18            | 6.1     | Update input signal timing                           |
|          |              | 25            | 9.1     | Update carton drawing                                |
|          |              | 20            | 7.2     | Update optical spec                                  |
| Ver. 2.0 | Jan.18, 2010 | 20            | 7.2     | Update optical characteristic                        |
|          |              | 25            | 9.1     | Update carton drawing                                |
| Ver. 3.0 | May.27, 2010 | All           | All     | Approval spec 3.0 is first issued                    |



## 1. GENERAL DESCRIPTION

### 1.1 OVERVIEW

N156B3-L0B is a 15.6" (15.547" diagonal) TFT Liquid Crystal Display module with CCFL Backlight unit and 30 pins LVDS interface. This module supports 1366 x 768 HD mode and can display 262,144 colors.

The optimum viewing angle is at 6 o'clock direction.

### 1.2 FEATURES

- HD (1366 x 768 pixels) resolution
- 3.3V LVDS (Low Voltage Differential Signaling) interface
- CCFL

### 1.3 APPLICATION

- TFT LCD Notebook

### 1.4 GENERAL SPECIFICATIONS

| Item               | Specification                                | Unit  | Note |
|--------------------|--|-------|------|
| Active Area        | 344.232 (H) x 193.536 (V) (15.547" diagonal) | mm    | (1)  |
| Bezel Opening Area | 349.58 (H) x 198.4 (V)                       | mm    |      |
| Driver Element     | a-si TFT active matrix                       | -     | -    |
| Pixel Number       | 1366 x R.G.B. x 768                          | pixel | -    |
| Pixel Pitch        | 0.252 (H) x 0.252 (V)                        | mm    | -    |
| Pixel Arrangement  | RGB vertical stripe                          | -     | -    |
| Display Colors     | 262,144                                      | color | -    |
| Transmissive Mode  | Normally white                               | -     | -    |
| Surface Treatment  | Hard coating (3H), Glare                     | -     | -    |
| Backlight Unit     | 1 CCFL                                       |       |      |
| Power Consumption  | 5.376 typ/5.475 max@Black Pattern            | Watt  |      |
| RoHS               | Yes  |       |      |

### 1.5 MECHANICAL SPECIFICATIONS

| Item        |               | Min.  | Typ.  | Max.  | Unit | Note |
|-------------|---------------|-------|-------|-------|------|------|
| Module Size | Horizontal(H) | 358.8 | 359.3 | 359.8 | mm   | (1)  |
|             | Vertical(V)   | 209   | 209.5 | 210   | mm   |      |
|             | Thickness(T)  | -     | 5.9   | 6.2   | mm   |      |
| Weight      |               | ---   | 465   | 480   | g    | -    |

Note (1) Please refer to the attached drawings for more information of front and back outline dimensions.



## 2. ABSOLUTE MAXIMUM RATINGS

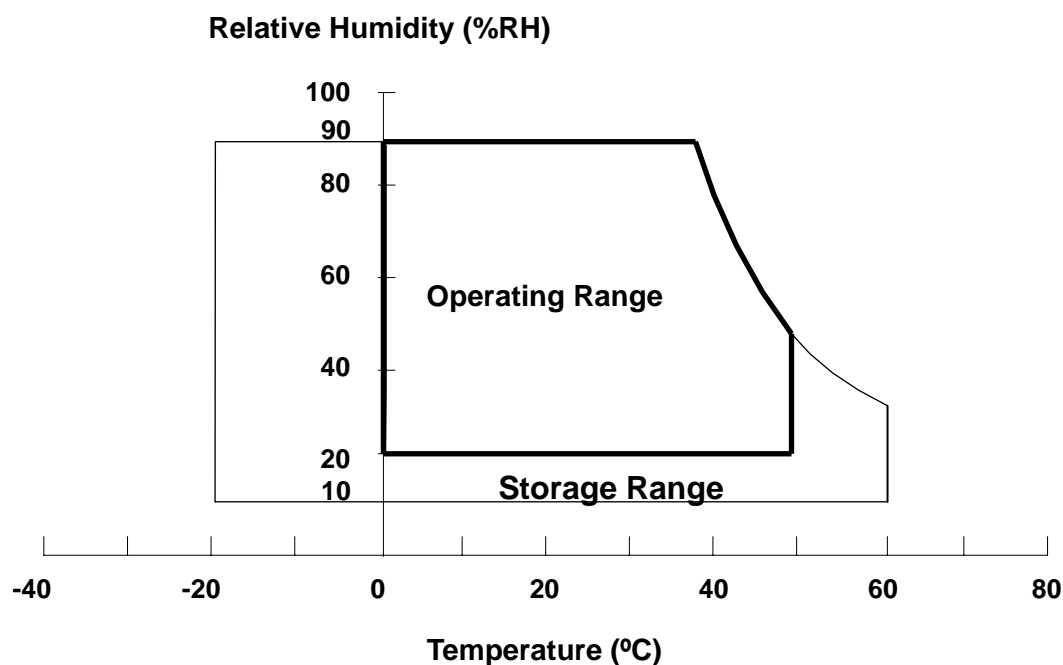
### 2.1 ABSOLUTE RATINGS OF ENVIRONMENT

| Item                          | Symbol           | Value |       | Unit | Note     |
|-------------------------------|------------------|-------|-------|------|----------|
|                               |                  | Min.  | Max.  |      |          |
| Storage Temperature           | T <sub>ST</sub>  | -20   | +60   | °C   | (1)      |
| Operating Ambient Temperature | T <sub>OP</sub>  | 0     | +50   | °C   | (1), (2) |
| Shock (Non-Operating)         | S <sub>NOP</sub> | -     | 220/2 | G/ms | (3), (5) |
| Vibration (Non-Operating)     | V <sub>NOP</sub> | -     | 1.5   | G    | (4), (5) |

#### 2.1.2 Reliability Test

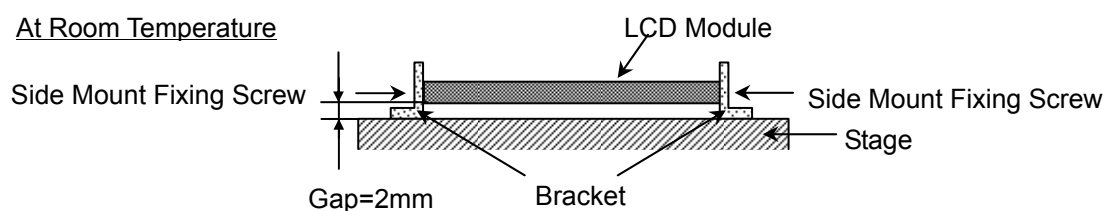
| No. | Test Item  | Test Condition                                | Note    |
|-----|--|---|---------|
| 1   | High Temperature Storage   | 60 , 240 hours                                | (1) (2) |
| 2   | Low Temperature Storage  | -20 , 240 hours                               |         |
| 3   | Thermal Shock Storage  | [(-20°C 30min)→(60°C 30min)]/cycle, 100cycles |         |
| 4   | High Temperature Operating   | 50 , 300 hours                                |         |
| 5   | Low Temperature Operating  | 0 , 300 hours                                 |         |
| 6   | High Temperature & High Humidity Operating                           | 50 , 80% RH, 300hours                         |         |
| 7   | High Temperature & High Humidity Storage                             | 40 , 90% RH, 240hours                         |         |
| 8   | Shock (Non-Operating)  | 220G, 2ms                                     | (3)(5)  |
| 9   | Vibration (Non-Operating)  | 1.5G, 10 to 500 Hz                            | (4)(5)  |
| 10  | ESD test (Operation)   | 150pF/330Ω<br>Contact Discharge : ±8KV        | (6)     |
|     |  | 150pF/330Ω<br>Air Discharge : ±15KV           |         |
| 11  | Connector ESD test(Non-operation)<br>(converter on PCB LED BLU only) | 100pF/1.5kΩ<br>Contact Discharge : ±2KV       | (6)     |

- Note (1) (a) 90 %RH Max. ( $T_a \leq 40\text{ }^{\circ}\text{C}$ ).  
 (b) Wet-bulb temperature should be  $39\text{ }^{\circ}\text{C}$  Max. ( $T_a > 40\text{ }^{\circ}\text{C}$ ).  
 (c) No condensation.
- Note (2) The temperature of panel surface should be  $0\text{ }^{\circ}\text{C}$  min. and  $60\text{ }^{\circ}\text{C}$  max.



- Note (3) 1 time for  $\pm X, \pm Y, \pm Z$ . for Condition (220G / 2ms) is half Sine Wave,.
- Note (4) 10~500 Hz, 0.5hr/cycle 1cycle for X,Y,Z
- Note (5) At testing Vibration and Shock, the fixture in holding the module has to be hard and rigid enough so that the module would not be twisted or bent by the fixture.  
 The fixing condition is shown as below:

At Room Temperature



- Note (6) According to IEC 61000-4-2



## 2.2 ELECTRICAL ABSOLUTE RATINGS

### 2.2.1 TFT LCD MODULE

| Item                 | Symbol          | Value |          | Unit | Note |
|----------------------|-----------------|-------|----------|------|------|
|                      |                 | Min.  | Max.     |      |      |
| Power Supply Voltage | VCCS            | -0.3  | +4.0     | V    | (1)  |
| Logic Input Voltage  | V <sub>IN</sub> | -0.3  | VCCS+0.3 | V    |      |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

### 2.2.2 BACKLIGHT UNIT

| Item           | Symbol         | Value |      | Unit              | Note                              |
|----------------|----------------|-------|------|-------------------|-----------------------------------|
|                |                | Min.  | Max. |                   |                                   |
| Lamp Voltage   | V <sub>L</sub> | --    | 720  | V <sub>RMS</sub>  | (1), (2), I <sub>L</sub> = 6.0 mA |
| Lamp Current   | I <sub>L</sub> | --    | 6    | mA <sub>RMS</sub> | (1), (2)                          |
| Lamp Frequency | F <sub>L</sub> | 40    | 60   | KHz               |                                   |

Note (1) Permanent damage to the device may occur if maximum values are exceeded. Function operation should be restricted to the conditions described under Normal Operating Conditions.

Note (2) Specified values are for lamp (Refer to Section 3.2 for further information).

### 3. ELECTRICAL CHARACTERISTICS

#### 3.1 TFT LCD MODULE

$T_a = 25 \pm 2^\circ\text{C}$

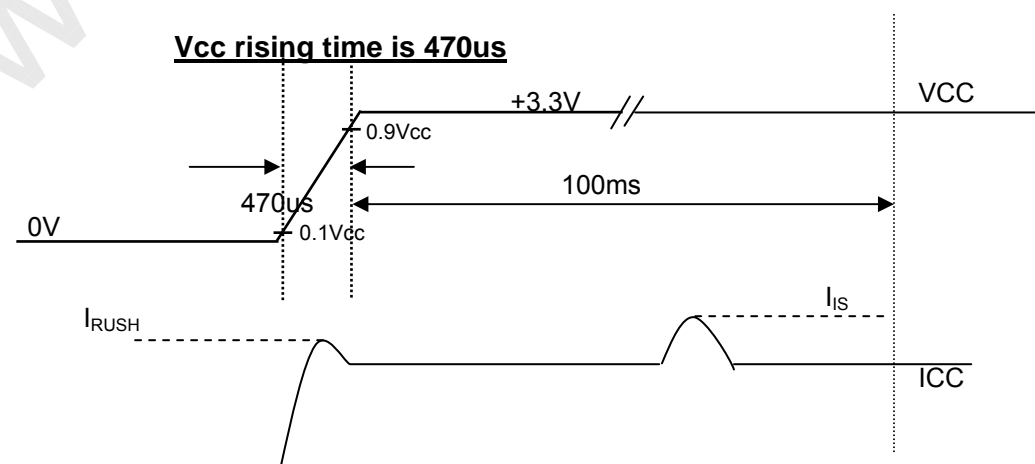
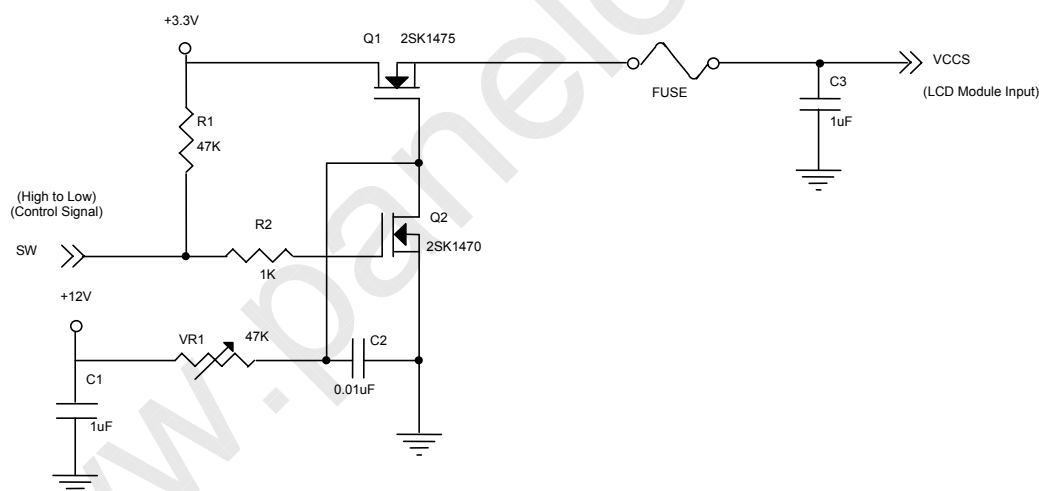
| Parameter                              | Symbol         | Value    |      |       | Unit | Note                  |
|--|----------------|----------|------|-------|------|-----------------------|
|  |                | Min.     | Typ. | Max.  |      |                       |
| Power Supply Voltage                   | VCCS           | 3.0      | 3.3  | 3.6   | V    | -                     |
| Ripple Voltage                         | $V_{RP}$       | -        | 50   | -     | mV   | -                     |
| Rush Current                           | $I_{RUSH}$     | -        | -    | 1.5   | A    | (2)                   |
| Initial Stage Current                  | $I_{IS}$       | -        | -    | 1.0   | A    | (2)                   |
| Power Supply Current                   | White          | $I_{CC}$ | 210  | 240   | mA   | (3)a                  |
|  | Black          |          | 320  | 350   |      | (3)b                  |
| LVDS Differential Input High Threshold | $V_{TH(LVDS)}$ | -        | -    | +100  | mV   | (4),<br>$V_{CM}=1.2V$ |
| LVDS Differential Input Low Threshold  | $V_{TL(LVDS)}$ | -100     | -    | -     | mV   | (4)<br>$V_{CM}=1.2V$  |
| LVDS Common Mode Voltage               | $V_{CM}$       | 1.125    | -    | 1.375 | V    | (4)                   |
| LVDS Differential Input Voltage        | $ V_{ID} $     | 100      | -    | 600   | mV   | (4)                   |
| LVDS Terminating Resistor              | $R_T$          | -        | 100  | -     | Ohm  | -                     |
| Power per EBL WG                       | PEBL           | -        | 2.9  | -     | W    | (5)                   |

Note (1) The ambient temperature is  $T_a = 25 \pm 2^\circ\text{C}$ .

Note (2)  $I_{RUSH}$ : the maximum current when VCCS is rising

$I_{IS}$ : the maximum current of the first 100ms after power-on

Measurement Conditions: Shown as the following figure. Test pattern: black.





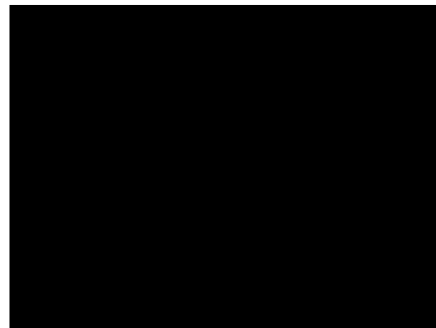
Note (3) The specified power supply current is under the conditions at  $V_{CCS} = 3.3\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ , DC Current and  $f_v = 60\text{ Hz}$ , whereas a power dissipation check pattern below is displayed.

a. White Pattern



Active Area

b. Black Pattern

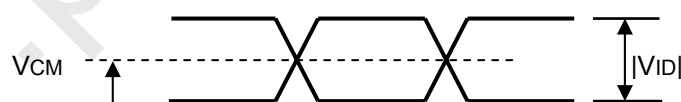
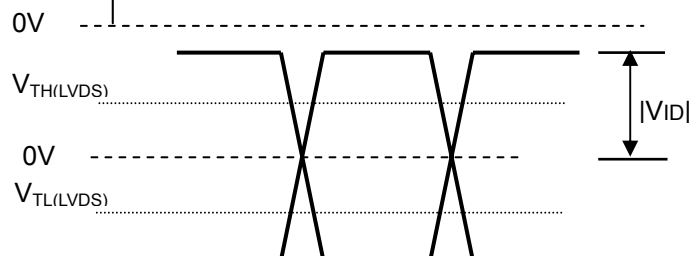


Active Area

Note (4) The specified power are the sum of LCD panel electronics input power and the inverter input power. Test conditions are as follows.

- (a)  $V_{CC} = 3.3\text{ V}$ ,  $T_a = 25 \pm 2\text{ }^{\circ}\text{C}$ ,  $f_v = 60\text{ Hz}$ ,
- (b) The pattern used is a black and white 32 x 36 checkerboard, slide #100 from the VESA file "Flat Panel Display Monitor Setup Patterns", FPDMSU.ppt.
- (c) Luminance: 60 nits.
- (d) The inverter used is provided from Sumida. Please contact them for detail information. CMO doesn't provide the inverter in this product.

Note (5) The parameters of LVDS signals are defined as the following figures.

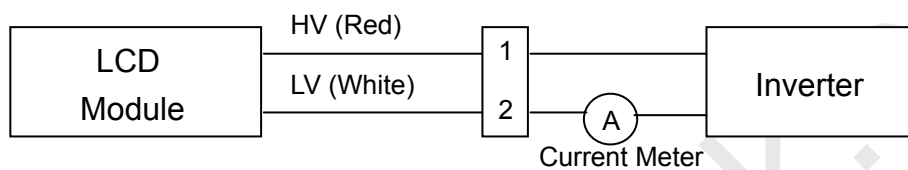
**Single Ended****Differential**

## 3.2 BACKLIGHT UNIT

Ta = 25 ± 2 °C

| Parameter            | Symbol          | Value  |      |             | Unit              | Note                         |
|----------------------|-----------------|--------|------|-------------|-------------------|------------------------------|
|                      |                 | Min.   | Typ. | Max.        |                   |                              |
| Lamp Input Voltage   | V <sub>L</sub>  | 648    | 720  | 792         | V <sub>RMS</sub>  | I <sub>L</sub> = 6.0 mA      |
| Lamp Current         | I <sub>L</sub>  | 2.0    | 6.0  | 7.0         | mA <sub>RMS</sub> | (1),(2)                      |
|                      |                 | 3.0    |      |             |                   | (1),(3)                      |
| Lamp Turn On Voltage | V <sub>S</sub>  | --     | --   | 1300(25 °C) | V <sub>RMS</sub>  | (4)                          |
|                      |                 | --     | --   | 1560(0 °C)  | V <sub>RMS</sub>  | (4)                          |
| Operating Frequency  | F <sub>L</sub>  | 40     | --   | 60          | KHz               | (5)                          |
| Lamp Life Time       | L <sub>BL</sub> | 15,000 | --   | --          | Hrs               | (7)                          |
| Power Consumption    | P <sub>L</sub>  | --     | 4.32 | --          | W                 | (6), I <sub>L</sub> = 6.0 mA |

Note (1) Lamp current is measured by utilizing a high frequency current meter as shown below:



Note (2) for burst mode inverter design

Note (3) for continuous mode inverter design

Note (4) The voltage that must be larger than V<sub>S</sub> should be applied to the lamp for more than 1 second after startup. Otherwise, the lamp may not be turned on normally.

Note (5) The lamp frequency may generate interference with horizontal synchronous frequency from the display, and this may cause line flow on the display. In order to avoid interference, the lamp frequency should be detached from the horizontal synchronous frequency and its harmonics as far as possible.

Note (6)  $P_L = I_L \times V_L$

Note (7) The lifetime of lamp is defined as the time when it continues to operate under the conditions at Ta = 25 ± 2 °C and I<sub>L</sub> = 6.0 mA<sub>RMS</sub> until one of the following events occurs:

(a) When the brightness becomes 50% of its original value.

(b) When the effective ignition length becomes 80% of its original value. (The effective ignition length is a scope that luminance is over 70% of that at the center point.)

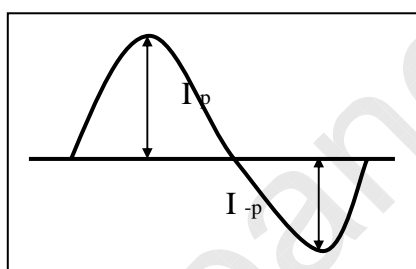
Note (8) The waveform of the voltage output of inverter must be area-symmetric and the design of the inverter must have specifications for the modularized lamp. The performance of the Backlight, such as lifetime or brightness, is greatly influenced by the characteristics of the DC-AC inverter for the lamp. All the parameters of an inverter should be carefully designed to avoid generating too much current leakage from high voltage output of the inverter. When designing or ordering the inverter please make sure that a poor lighting caused by the mismatch of the Backlight and the

inverter (miss-lighting, flicker, etc.) never occurs. If the above situation is confirmed, the module should be operated in the same manners when it is installed in your instrument.

The output of the inverter must have symmetrical (negative and positive) voltage waveform and symmetrical current waveform. (Unsymmetrical ratio is less than 10%) Please do not use the inverter, which has unsymmetrical voltage and unsymmetrical current and spike wave. Lamp frequency may produce interface with horizontal synchronous frequency and as a result this may cause beat on the display. Therefore lamp frequency shall be as away possible from the horizontal synchronous frequency and from its harmonics in order to prevent interference.

Requirements for a system inverter design, which is intended to have a better display performance, a better power efficiency and a more reliable lamp. It shall help increase the lamp lifetime and reduce its leakage current.

- The asymmetry rate of the inverter waveform should be 10% below;
- The distortion rate of the waveform should be within  $2 \pm 10\%$ ;
- The ideal sine wave form shall be symmetric in positive and negative polarities.



\* Asymmetry rate:

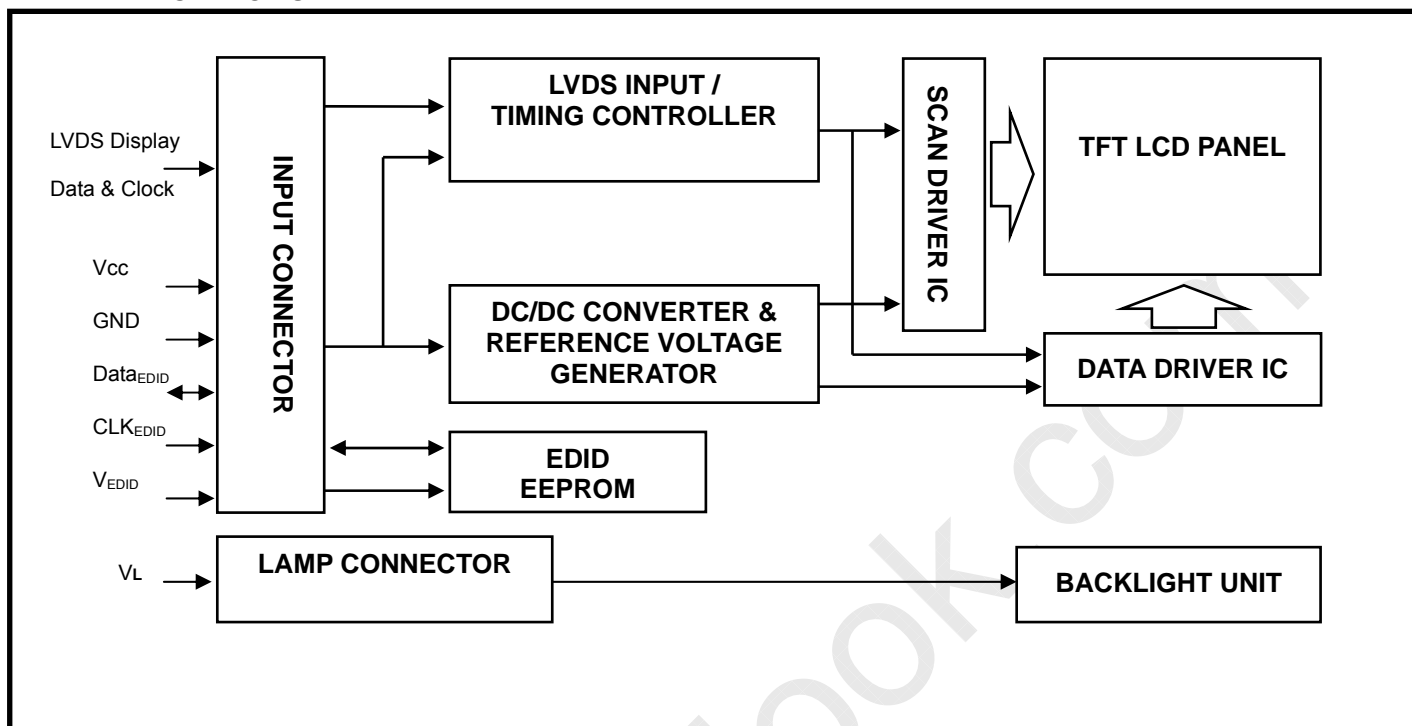
$$|I_p - I_{-p}| / I_{rms} * 100\%$$

\* Distortion rate

$$I_p \text{ (or } I_{-p}) / I_{rms}$$

## 4. BLOCK DIAGRAM

### 4.1 TFT LCD MODULE



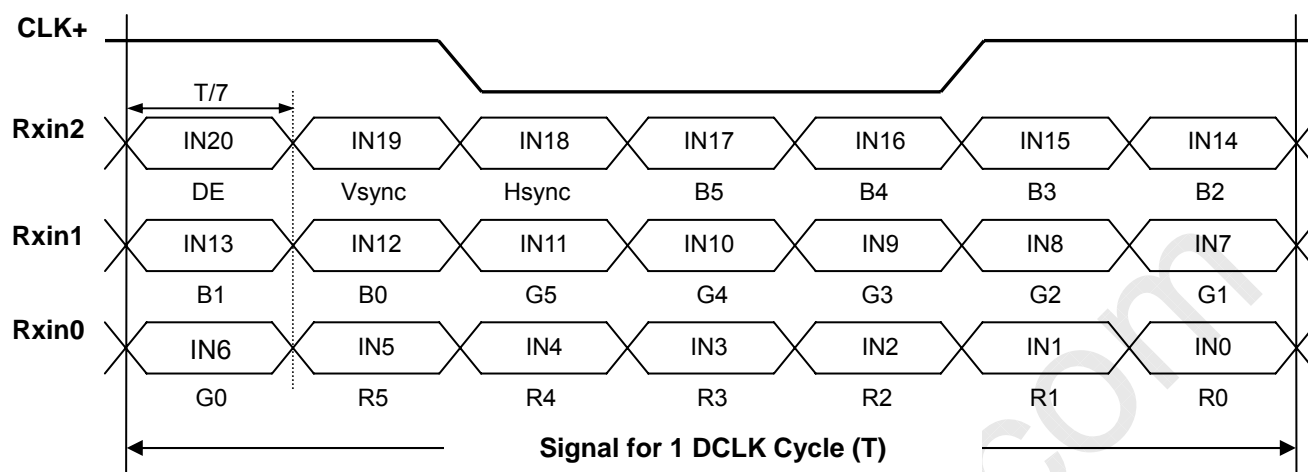
### 4.2 BACKLIGHT UNIT







## 5.2 TIMING DIAGRAM OF LVDS INPUT SIGNAL





### 5.3 COLOR DATA INPUT ASSIGNMENT

The brightness of each primary color (red, green and blue) is based on the 6-bit gray scale data input for the color. The higher the binary input the brighter the color. The table below provides the assignment of color versus data input.

| Color               |               | Data Signal |    |    |    |    |    |       |    |    |    |    |    |      |    |    |    |    |    |
|---------------------|---------------|-------------|----|----|----|----|----|-------|----|----|----|----|----|------|----|----|----|----|----|
|                     |               | Red         |    |    |    |    |    | Green |    |    |    |    |    | Blue |    |    |    |    |    |
|                     |               | R5          | R4 | R3 | R2 | R1 | R0 | G5    | G4 | G3 | G2 | G1 | G0 | B5   | B4 | B3 | B2 | B1 | B0 |
| Basic Colors        | Black         | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red           | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green         | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Blue          | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Cyan          | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Magenta       | 1           | 1  | 1  | 1  | 1  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 1  |
|                     | Yellow        | 1           | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | White         | 1           | 1  | 1  | 1  | 1  | 1  | 1     | 1  | 1  | 1  | 1  | 1  | 1    | 1  | 1  | 1  | 1  | 1  |
| Gray Scale Of Red   | Red(0)/Dark   | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red(1)        | 0           | 0  | 0  | 0  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red(2)        | 0           | 0  | 0  | 0  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | Red(61)       | 1           | 1  | 1  | 1  | 0  | 1  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Red(62)       | 1           | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
| Red(63)             | 1             | 1           | 1  | 1  | 1  | 1  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  |    |
| Gray Scale Of Green | Green(0)/Dark | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green(1)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green(2)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | Green(61)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 0  | 1  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Green(62)     | 0           | 0  | 0  | 0  | 0  | 0  | 1     | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
| Green(63)           | 0             | 0           | 0  | 0  | 0  | 0  | 1  | 1     | 1  | 1  | 1  | 1  | 0  | 0    | 0  | 0  | 0  | 0  |    |
| Gray Scale Of Blue  | Blue(0)/Dark  | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 0  |
|                     | Blue(1)       | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 0  | 1  |
|                     | Blue(2)       | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 0    | 0  | 0  | 0  | 1  | 0  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | :             | :           | :  | :  | :  | :  | :  | :     | :  | :  | :  | :  | :  | :    | :  | :  | :  | :  | :  |
|                     | Blue(61)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 0  | 1  |
|                     | Blue(62)      | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 0  | 1    | 1  | 1  | 1  | 1  | 0  |
| Blue(63)            | 0             | 0           | 0  | 0  | 0  | 0  | 0  | 0     | 0  | 0  | 0  | 0  | 1  | 1    | 1  | 1  | 1  | 1  |    |

Note (1) 0: Low Level Voltage, 1: High Level Voltage



## 5.4 EDID DATA STRUCTURE

The EDID (Extended Display Identification Data) data formats are to support displays as defined in the VESA Plug & Display and FPD standards.

| Byte #<br>(decimal) | Byte #<br>(hex) | Field Name and Comments                             | Value<br>(hex) | Value<br>(binary) |
|---------------------|-----------------|---|----------------|-------------------|
| 0                   | 0               | Header  | 00             | 00000000          |
| 1                   | 1               | Header  | FF             | 11111111          |
| 2                   | 2               | Header  | FF             | 11111111          |
| 3                   | 3               | Header  | FF             | 11111111          |
| 4                   | 4               | Header  | FF             | 11111111          |
| 5                   | 5               | Header  | FF             | 11111111          |
| 6                   | 6               | Header  | FF             | 11111111          |
| 7                   | 7               | Header  | 00             | 00000000          |
| 8                   | 8               | EISA ID manufacturer name ("CMO")                   | 0D             | 00001101          |
| 9                   | 9               | EISA ID manufacturer name (Compressed ASCII)        | AF             | 10101111          |
| 10                  | 0A              | ID product code (N156B3-L0B)                        | 93             | 10010011          |
| 11                  | 0B              | ID product code (hex LSB first; N156B3-L0B)         | 15             | 00010101          |
| 12                  | 0C              | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 13                  | 0D              | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 14                  | 0E              | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 15                  | 0F              | ID S/N (fixed "0")                                  | 00             | 00000000          |
| 16                  | 10              | Week of manufacture (fixed "00H")                   | 08             | 00001000          |
| 17                  | 11              | Year of manufacture (fixed "00H")                   | 14             | 00010100          |
| 18                  | 12              | EDID structure version # ("1")                      | 01             | 00000001          |
| 19                  | 13              | EDID revision # ("3")                               | 03             | 00000011          |
| 20                  | 14              | Video I/P definition ("digital")                    | 80             | 10000000          |
| 21                  | 15              | Max H image size ("34.42cm")                        | 22             | 00100010          |
| 22                  | 16              | Max V image size ("19.35cm")                        | 13             | 00010011          |
| 23                  | 17              | Display Gamma (Gamma = "2.2")                       | 78             | 01111000          |
| 24                  | 18              | Feature support ("Active off, RGB Color")           | 0A             | 00001010          |
| 25                  | 19              | Red/Green (Rx1, Rx0, Ry1, Ry0, Gx1, Gx0, Gy1, Gy0)  | D1             | 11010001          |
| 26                  | 1A              | Blue/White (Bx1, Bx0, By1, By0, Wx1, Wx0, Wy1, Wy0) | F5             | 11110101          |
| 27                  | 1B              | Red-x (Rx = "0.577")                                | 93             | 10010011          |
| 28                  | 1C              | Red-y (Ry = "0.364")                                | 5D             | 01011101          |
| 29                  | 1D              | Green-x (Gx = "0.348")                              | 59             | 01011001          |
| 30                  | 1E              | Green-y (Gy = "0.563")                              | 90             | 10010000          |
| 31                  | 1F              | Blue-x (Bx = "0.151")                               | 26             | 00100110          |
| 32                  | 20              | Blue-y (By = "0.116")                               | 1D             | 00011101          |
| 33                  | 21              | White-x (Wx = "0.313")                              | 50             | 01010000          |
| 34                  | 22              | White-y (Wy = "0.329")                              | 54             | 01010100          |
| 35                  | 23              | Established timings 1                               | 00             | 00000000          |
| 36                  | 24              | Established timings 2                               | 00             | 00000000          |
| 37                  | 25              | Manufacturer's reserved timings                     | 00             | 00000000          |
| 38                  | 26              | Standard timing ID # 1                              | 01             | 00000001          |
| 39                  | 27              | Standard timing ID # 1                              | 01             | 00000001          |
| 40                  | 28              | Standard timing ID # 2                              | 01             | 00000001          |



**Approval**

|    |    |  |    |          |
|----|----|--|----|----------|
| 41 | 29 | Standard timing ID # 2   | 01 | 00000001 |
| 42 | 2A | Standard timing ID # 3   | 01 | 00000001 |
| 43 | 2B | Standard timing ID # 3   | 01 | 00000001 |
| 44 | 2C | Standard timing ID # 4   | 01 | 00000001 |
| 45 | 2D | Standard timing ID # 4   | 01 | 00000001 |
| 46 | 2E | Standard timing ID # 5   | 01 | 00000001 |
| 47 | 2F | Standard timing ID # 5   | 01 | 00000001 |
| 48 | 30 | Standard timing ID # 6   | 01 | 00000001 |
| 49 | 31 | Standard timing ID # 6   | 01 | 00000001 |
| 50 | 32 | Standard timing ID # 7   | 01 | 00000001 |
| 51 | 33 | Standard timing ID # 7   | 01 | 00000001 |
| 52 | 34 | Standard timing ID # 8   | 01 | 00000001 |
| 53 | 35 | Standard timing ID # 8   | 01 | 00000001 |
| 54 | 36 | Detailed timing description # 1 Pixel clock ("69.3MHz", According to VESA CVT Rev1.1)    | 12 | 00010010 |
| 55 | 37 | # 1 Pixel clock (hex LSB first)  | 1B | 00011011 |
| 56 | 38 | # 1 H active ("1366")  | 56 | 01010110 |
| 57 | 39 | # 1 H blank ("100")  | 64 | 01100100 |
| 58 | 3A | # 1 H active : H blank ("1366 :100")   | 50 | 01010000 |
| 59 | 3B | # 1 V active ("768")   | 00 | 00000000 |
| 60 | 3C | # 1 V blank ("20")   | 14 | 00010100 |
| 61 | 3D | # 1 V active : V blank ("768 :20")   | 30 | 00110000 |
| 62 | 3E | # 1 H sync offset ("16")   | 10 | 00010000 |
| 63 | 3F | # 1 H sync pulse width ("34")  | 22 | 00100010 |
| 64 | 40 | # 1 V sync offset : V sync pulse width ("2 : 6")   | 26 | 00100110 |
| 65 | 41 | # 1 H sync offset : H sync pulse width : V sync offset : V sync width ("16: 34 : 2 : 6") | 00 | 00000000 |
| 66 | 42 | # 1 H image size ("344 mm")  | 58 | 01011000 |
| 67 | 43 | # 1 V image size ("193 mm")  | C1 | 11000001 |
| 68 | 44 | # 1 H image size : V image size ("344 : 193")  | 10 | 00010000 |
| 69 | 45 | # 1 H boarder ("0")  | 00 | 00000000 |
| 70 | 46 | # 1 V boarder ("0")  | 00 | 00000000 |
| 71 | 47 | # 1 Non-interlaced, Normal, no stereo, Separate sync, H/V pol Negatives                  | 18 | 00011000 |
| 72 | 48 | Detailed timing description # 2  | 00 | 00000000 |
| 73 | 49 | # 2 Flag   | 00 | 00000000 |
| 74 | 4A | # 2 Reserved   | 00 | 00000000 |
| 75 | 4B | # 2 FE (hex) defines ASCII string (Model Name "N156B3-L0B", ASCII)                       | FE | 11111110 |
| 76 | 4C | # 2 Flag   | 00 | 00000000 |
| 77 | 4D | # 2 1st character of name ("N")  | 4E | 01001110 |
| 78 | 4E | # 2 2nd character of name ("1")  | 31 | 00110001 |
| 79 | 4F | # 2 3rd character of name ("5")  | 35 | 00110101 |
| 80 | 50 | # 2 4th character of name ("6")  | 36 | 00110110 |
| 81 | 51 | # 2 5th character of name ("B")  | 42 | 01000010 |
| 82 | 52 | # 2 6th character of name ("3")  | 33 | 00110011 |
| 83 | 53 | # 2 7th character of name ("-")  | 2D | 00101101 |
| 84 | 54 | # 2 8th character of name ("L")  | 4C | 01001100 |
| 85 | 55 | # 2 9th character of name ("0")  | 30 | 00110000 |



|     |    |   |    |          |
|-----|----|---|----|----------|
| 86  | 56 | # 2 9th character of name ("B")                                   | 42 | 01000010 |
| 87  | 57 | # 2 New line character indicates end of ASCII string              | 0A | 00001010 |
| 88  | 58 | # 2 Padding with "Blank" character                                | 20 | 00100000 |
| 89  | 59 | # 2 Padding with "Blank" character                                | 20 | 00100000 |
| 90  | 5A | Detailed timing description # 3                                   | 00 | 00000000 |
| 91  | 5B | # 3 Flag  | 00 | 00000000 |
| 92  | 5C | # 3 Reserved  | 00 | 00000000 |
| 93  | 5D | # 3 FE (hex) defines ASCII string (Vendor "CMO", ASCII)           | FE | 11111110 |
| 94  | 5E | # 3 Flag  | 00 | 00000000 |
| 95  | 5F | # 3 1st character of string ("C")                                 | 43 | 01000011 |
| 96  | 60 | # 3 2nd character of string ("M")                                 | 4D | 01001101 |
| 97  | 61 | # 3 3rd character of string ("O")                                 | 4F | 01001111 |
| 98  | 62 | # 3 New line character indicates end of ASCII string              | 0A | 00001010 |
| 99  | 63 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 100 | 64 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 101 | 65 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 102 | 66 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 103 | 67 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 104 | 68 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 105 | 69 | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 106 | 6A | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 107 | 6B | # 3 Padding with "Blank" character                                | 20 | 00100000 |
| 108 | 6C | Detailed timing description # 4                                   | 00 | 00000000 |
| 109 | 6D | # 4 Flag  | 00 | 00000000 |
| 110 | 6E | # 4 Reserved  | 00 | 00000000 |
| 111 | 6F | # 4 FE (hex) defines ASCII string (Model Name"N156B3-L0B", ASCII) | FE | 11111110 |
| 112 | 70 | # 4 Flag  | 00 | 00000000 |
| 113 | 71 | # 4 1st character of name ("N")                                   | 4E | 01001110 |
| 114 | 72 | # 4 2nd character of name ("1")                                   | 31 | 00110001 |
| 115 | 73 | # 4 3rd character of name ("5")                                   | 35 | 00110101 |
| 116 | 74 | # 4 4th character of name ("6")                                   | 36 | 00110110 |
| 117 | 75 | # 4 5th character of name ("B")                                   | 42 | 01000010 |
| 118 | 76 | # 4 6th character of name ("3")                                   | 33 | 00110011 |
| 119 | 77 | # 4 7th character of name ("-")                                   | 2D | 00101101 |
| 120 | 78 | # 4 8th character of name ("L")                                   | 4C | 01001100 |
| 121 | 79 | # 4 9th character of name ("0")                                   | 30 | 00110000 |
| 122 | 7A | # 4 9th character of name ("B")                                   | 42 | 01000010 |
| 123 | 7B | # 4 New line character indicates end of ASCII string              | 0A | 00001010 |
| 124 | 7C | # 4 Padding with "Blank" character                                | 20 | 00100000 |
| 125 | 7D | # 4 Padding with "Blank" character                                | 20 | 00100000 |
| 126 | 7E | Extension flag  | 00 | 00000000 |
| 127 | 7F | Checksum  | 76 | 01110110 |

## 6. INTERFACE TIMING

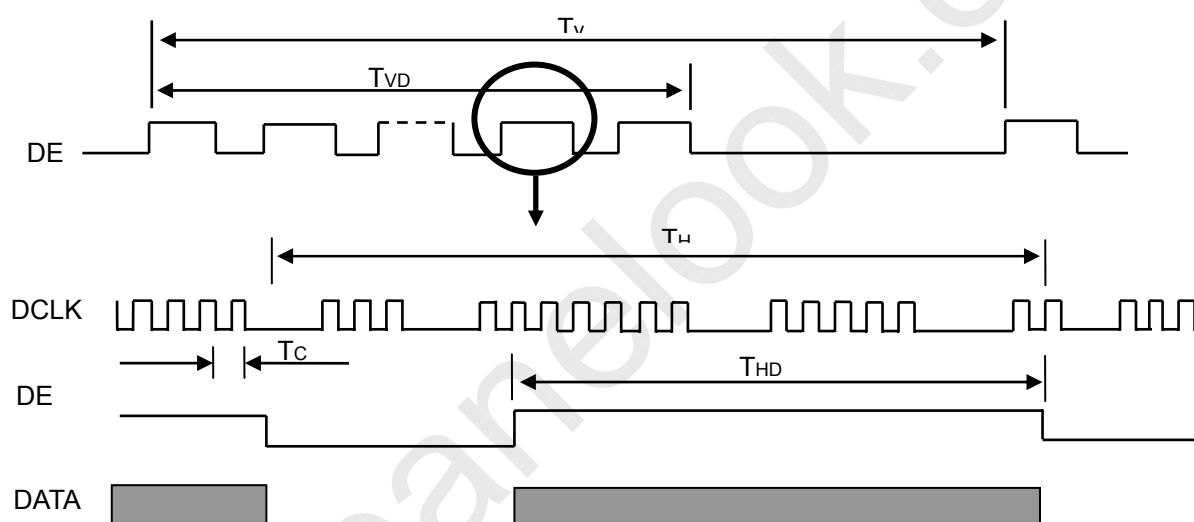
### 6.1 INPUT SIGNAL TIMING SPECIFICATIONS

The input signal timing specifications are shown as the following table and timing diagram.

| Signal | Item                              | Symbol | Min.   | Typ.  | Max.   | Unit | Note |
|--------|-----------------------------------|--------|--------|-------|--------|------|------|
| DCLK   | Frequency                         | 1/Tc   | 62.38  | 69.31 | 72.77  | MHz  | -    |
| DE     | Vertical Total Time               | TV     | 773    | 788   | 985    | TH   | -    |
|        | Vertical Active Display Period    | TVD    | 768    | 768   | 768    | TH   | -    |
|        | Vertical Active Blanking Period   | TVB    | TV-TVD | 20    | TV-TVD | TH   | -    |
|        | Horizontal Total Time             | TH     | 1412   | 1466  | 1708   | Tc   | -    |
|        | Horizontal Active Display Period  | THD    | 1366   | 1366  | 1366   | Tc   | -    |
|        | Horizontal Active Blanking Period | THB    | TH-THD | 100   | TH-THD | Tc   | -    |

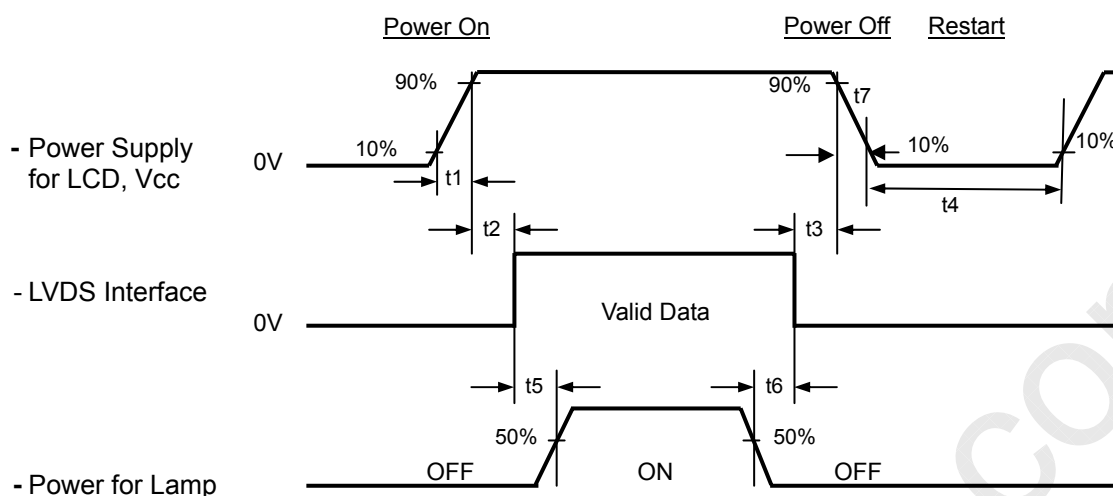
Note (1) Because this module is operated by DE only mode, Hsync and Vsync are ignored.

#### INPUT SIGNAL TIMING DIAGRAM





## 6.2 POWER ON/OFF SEQUENCE



## Timing Specifications:

|     |       |        |
|-----|-------|--------|
| 0.5 | $t_1$ | 10 ms  |
| 0   | $t_2$ | 50 ms  |
| 0   | $t_3$ | 50 ms  |
|     | $t_4$ | 500 ms |
|     | $t_5$ | 200 ms |
|     | $t_6$ | 200 ms |

Note (1) Please follow the power on/off sequence described above. Otherwise, the LCD module might be damaged.

Note (2) Please avoid floating state of interface signal at invalid period. When the interface signal is invalid, be sure to pull down the power supply of LCD Vcc to 0 V.

Note (3) The Backlight inverter power must be turned on after the power supply for the logic and the interface signal is valid. The Backlight inverter power must be turned off before the power supply for the logic and the interface signal is invalid.

Note (4) Sometimes some slight noise shows when LCD is turned off (even backlight is already off). To avoid this phenomenon, we suggest that the Vcc falling time is better to follow  $50 \mu s \leq t_7 \leq 300 ms$ .



## 7. OPTICAL CHARACTERISTICS

### 7.1 TEST CONDITIONS

| Item                | Symbol  | Value | Unit |
|---------------------|---|-------|------|
| Ambient Temperature | Ta  | 25±2  | °C   |
| Ambient Humidity    | Ha  | 50±10 | %RH  |
| Supply Voltage      | V <sub>CC</sub>   | 3.3   | V    |
| Input Signal        | According to typical value in "3. ELECTRICAL CHARACTERISTICS" |       |      |
| CCFL Input Current  | I <sub>L</sub>  | 6     | mA   |

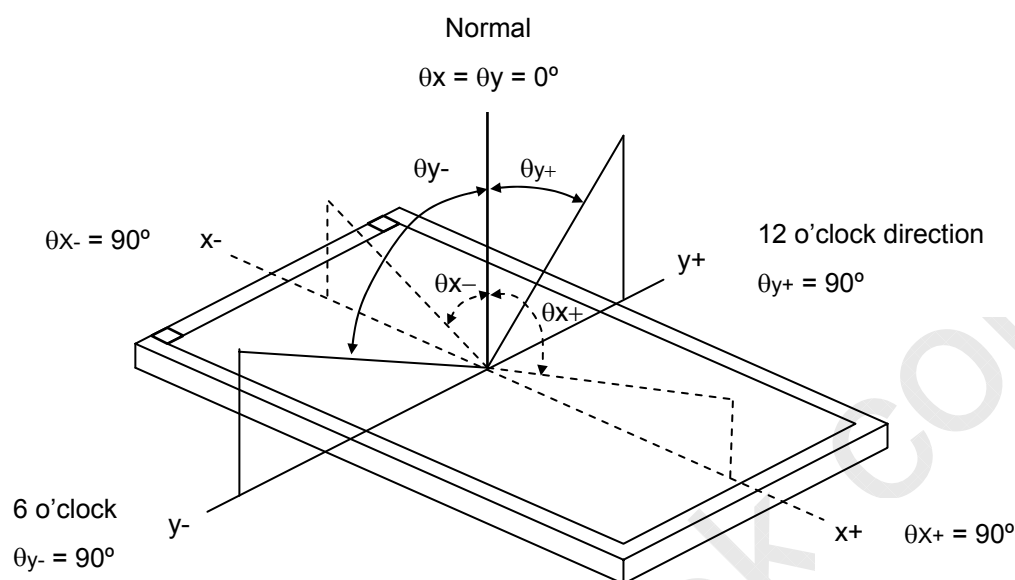
The measurement methods of optical characteristics are shown in Section 8.2. The following items should be measured under the test conditions described in Section 8.1 and stable environment shown in Note (5).

### 7.2 OPTICAL SPECIFICATIONS

| Item                        |            | Symbol           | Condition  | Min.          | Typ.          | Max.  | Unit              | Note            |
|-----------------------------|------------|------------------|--|---------------|---------------|-------|-------------------|-----------------|
| Contrast Ratio              |            | CR               | $\theta_x=0^\circ, \theta_Y=0^\circ$<br>Viewing Normal Angle | 350           | 500           | --    | NA                | (2), (5)<br>(7) |
| Response Time               |            | T <sub>R</sub>   |  | --            | 3             | 8     | ms                | (3) (7)         |
|                             |            | T <sub>F</sub>   |  | --            | 7             | 12    | ms                |                 |
| Average Luminance of White  |            | L <sub>Ave</sub> |  | 160           | 200           | --    | cd/m <sup>2</sup> | (4), (6)<br>(7) |
| Color Chromaticity          | Red        | R <sub>x</sub>   |  | Typ –<br>0.03 | Typ +<br>0.03 | 0.578 | NA                | (1) (7)         |
|                             |            | R <sub>y</sub>   |  |               |               | 0.339 | NA                |                 |
|                             | Green      | G <sub>x</sub>   |  |               |               | 0.312 | NA                |                 |
|                             |            | G <sub>y</sub>   |  |               |               | 0.556 | NA                |                 |
|                             | Blue       | B <sub>x</sub>   |  |               |               | 0.158 | NA                |                 |
|                             |            | B <sub>y</sub>   |  |               |               | 0.149 | NA                |                 |
|                             | White      | W <sub>x</sub>   |  |               |               | 0.313 | NA                |                 |
|                             |            | W <sub>y</sub>   |  |               |               | 0.329 | NA                |                 |
| Viewing Angle               | Horizontal | θ <sub>x</sub> + | CR≥10  | 40            | 45            | --    | Deg.              | (1),(5)<br>(7)  |
|                             |            | θ <sub>x</sub> - |  | 40            | 45            | --    |                   |                 |
|                             | Vertical   | θ <sub>y</sub> + |  | 15            | 20            | --    |                   |                 |
|                             |            | θ <sub>y</sub> - |  | 40            | 45            | --    |                   |                 |
| White Variation of 5 Points |            | δW <sub>5p</sub> | $\theta_x=0^\circ, \theta_Y=0^\circ$                         |               | 1.25          | 1.4   |                   | (5),(6)<br>(7)  |
|                             |            |                  |  |               | 1.4           | 1.6   |                   |                 |



Note (1) Definition of Viewing Angle ( $\theta_x$ ,  $\theta_y$ ):



Note (2) Definition of Contrast Ratio (CR):

The contrast ratio can be calculated by the following expression.

$$\text{Contrast Ratio (CR)} = L_{63} / L_0$$

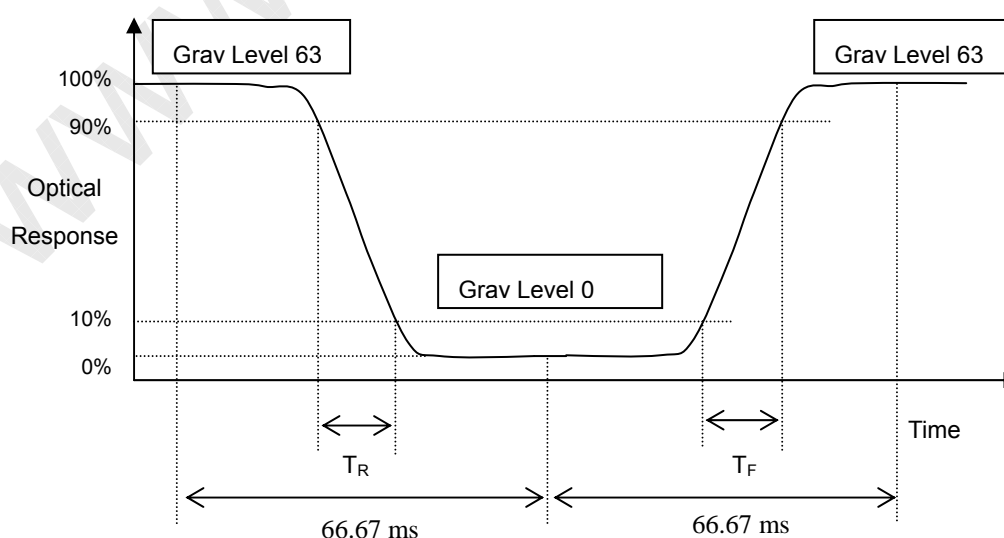
L63: Luminance of gray level 63

L 0: Luminance of gray level 0

$$CR = CR(1)$$

CR (X) is corresponding to the Contrast Ratio of the point X at Figure in Note (6).

Note (3) Definition of Response Time ( $T_R$ ,  $T_F$ ):



**Note (4) Definition of Average Luminance of White ( $L_{AVE}$ ):**

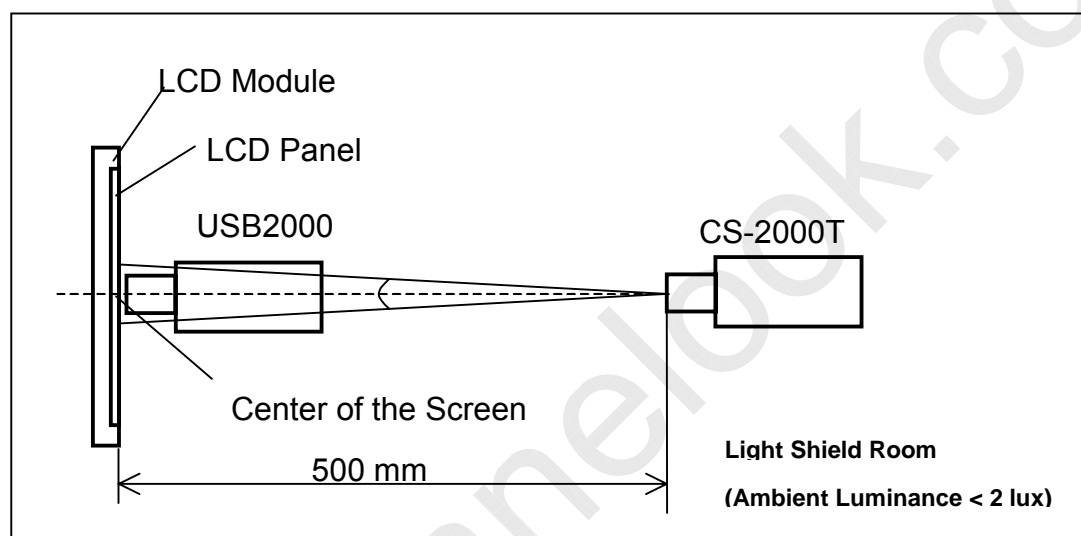
Measure the luminance of gray level 63 at 5 points

$$L_{AVE} = [L(1) + L(2) + L(3) + L(4) + L(5)] / 5$$

$L(x)$  is corresponding to the luminance of the point X at Figure in Note (6)

**Note (5) Measurement Setup:**

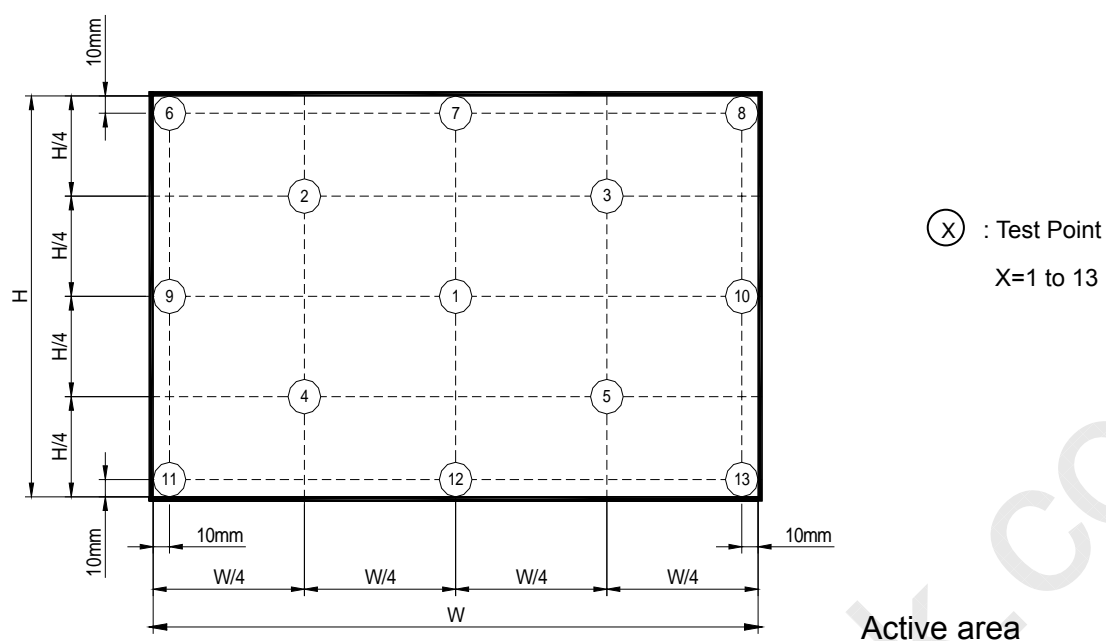
The LCD module should be stabilized at given temperature for 20 minutes to avoid abrupt temperature change during measuring. In order to stabilize the luminance, the measurement should be executed after lighting Backlight for 20 minutes in a windless room.

**Note (6) Definition of White Variation ( $\delta W$ ):**

Measure the luminance of gray level 63 at 5 points

$$\delta W_{5p} = \text{Maximum } [L(1), L(2), L(3), L(4), L(5)] / \text{Minimum } [L(1), L(2), L(3), L(4), L(5)]$$

$$\delta W_{13p} = \text{Maximum } [L(1) \quad L(13)] / \text{Minimum } [L(1) \quad L(13)]$$



Note (7) The listed optical specifications refer to the initial value of manufacture, but the condition of the specifications after long-term operation will not be warranted.



## 8. PRECAUTIONS

### 8.1 HANDLING PRECAUTIONS

- (1) The module should be assembled into the system firmly by using every mounting hole. Be careful not to twist or bend the module.
- (2) While assembling or installing modules, it can only be in the clean area. The dust and oil may cause electrical short or damage the polarizer.
- (3) Use fingerstalls or soft gloves in order to keep display clean during the incoming inspection and assembly process.
- (4) Do not press or scratch the surface harder than a HB pencil lead on the panel because the polarizer is very soft and easily scratched.
- (5) If the surface of the polarizer is dirty, please clean it by some absorbent cotton or soft cloth. Do not use Ketone type materials (ex. Acetone), Ethyl alcohol, Toluene, Ethyl acid or Methyl chloride. It might permanently damage the polarizer due to chemical reaction.
- (6) Wipe off water droplets or oil immediately. Staining and discoloration may occur if they left on panel for a long time.
- (7) If the liquid crystal material leaks from the panel, it should be kept away from the eyes or mouth. In case of contacting with hands, legs or clothes, it must be washed away thoroughly with soap.
- (8) Protect the module from static electricity, it may cause damage to the C-MOS Gate Array IC.
- (9) Do not disassemble the module.
- (10) Do not pull or fold the LED wire.
- (11) Pins of I/F connector should not be touched directly with bare hands.

### 8.2 STORAGE PRECAUTIONS

- (1) High temperature or humidity may reduce the performance of module. Please store LCD module within the specified storage conditions.
- (2) It is dangerous that moisture come into or contacted the LCD module, because the moisture may damage LCD module when it is operating.
- (3) It may reduce the display quality if the ambient temperature is lower than 10 °C. For example, the response time will become slowly, and the starting voltage of LED will be higher than the room temperature.

### 8.3 OPERATION PRECAUTIONS

- (1) Do not pull the I/F connector in or out while the module is operating.
- (2) Always follow the correct power on/off sequence when LCD module is connecting and operating. This can prevent the CMOS LSI chips from damage during latch-up.
- (3) The startup voltage of Backlight is approximately 1000 Volts. It may cause electrical shock while assembling with converter. Do not disassemble the module or insert anything into the Backlight unit.

## 9. PACKING

### 9.1 CARTON

1. Box Dimensions : 489(L)\*382(W)\*320(H)
2. 20 modules/Carton

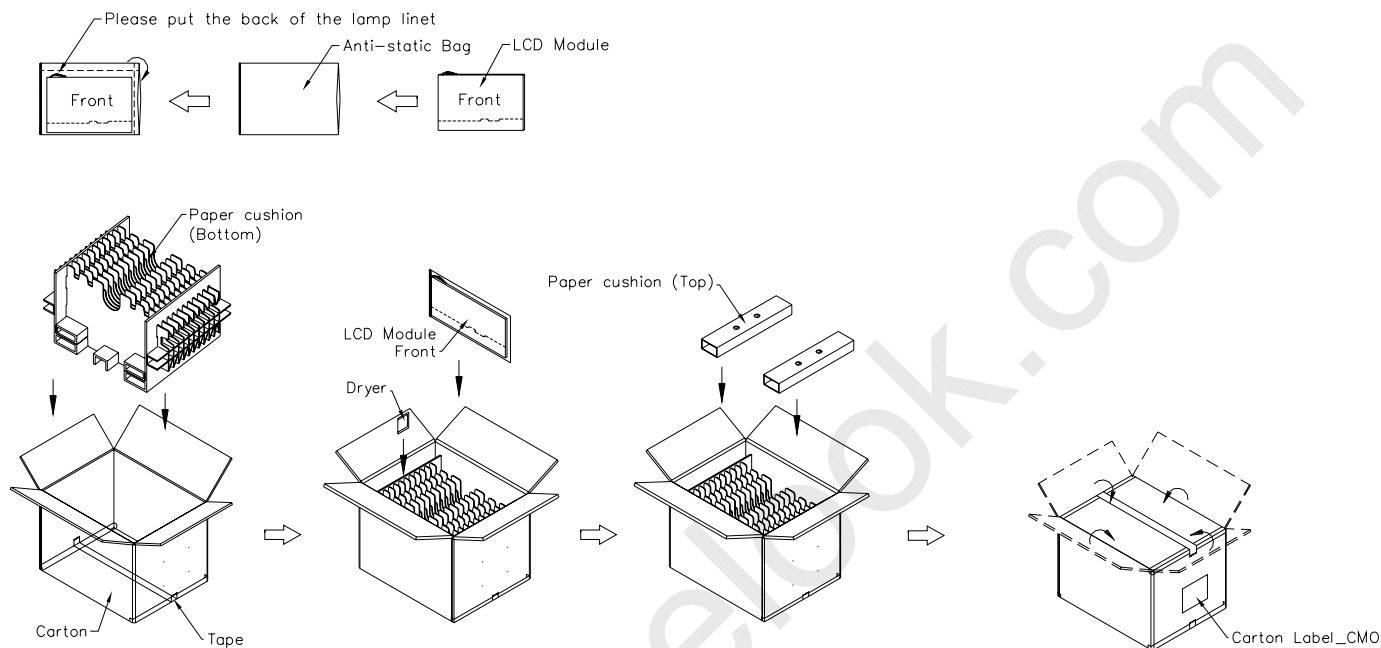
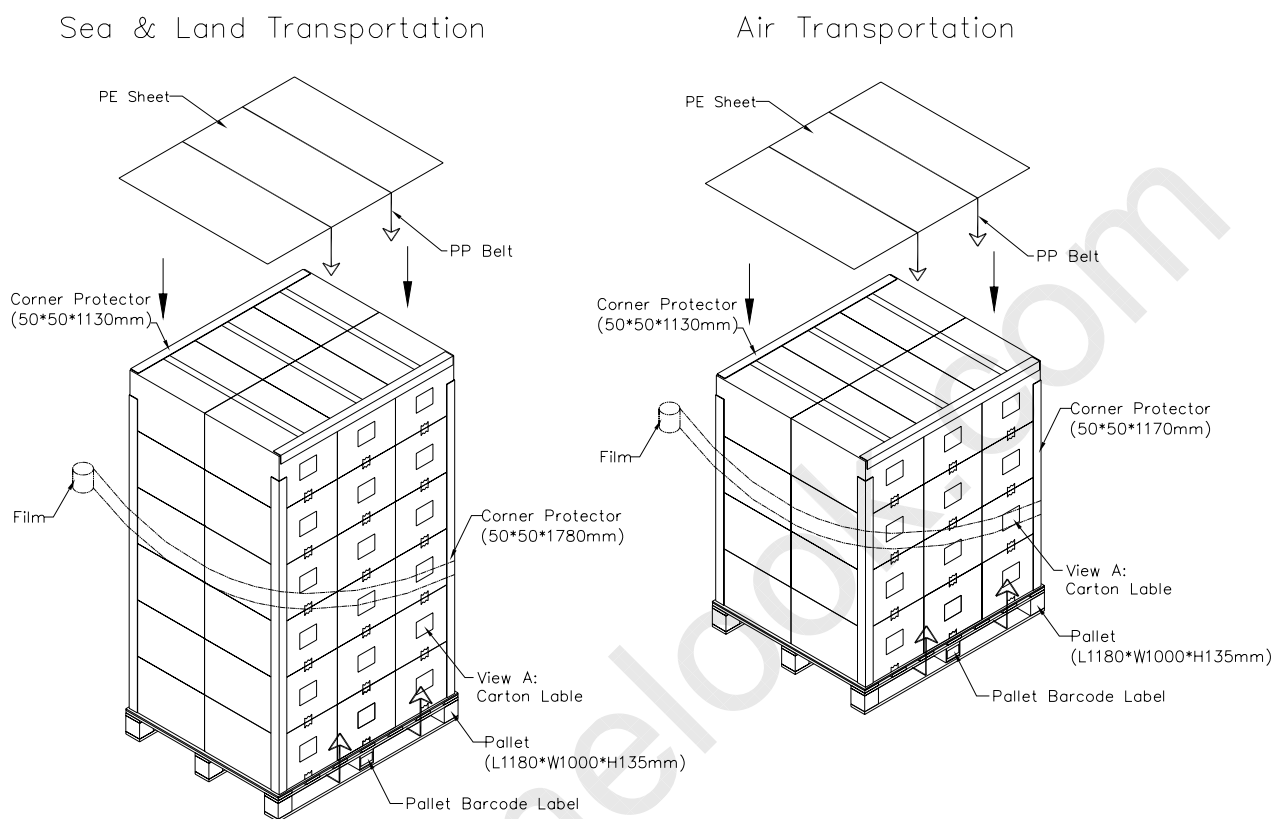


Figure. 10-1 Packing method



## 9.2 PALLET

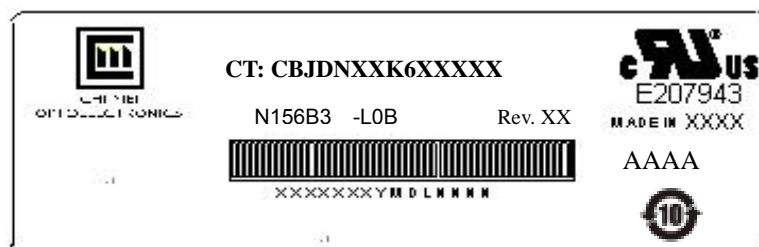


**Figure. 10-2 Packing method**

## 10. DEFINITION OF LABELS

### 10.1 CMO MODULE LABEL

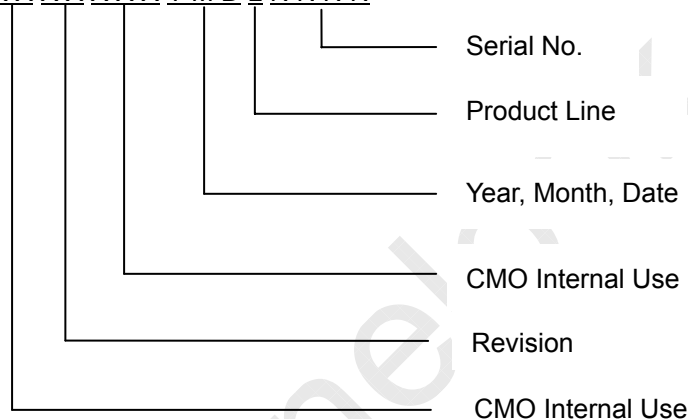
The barcode nameplate is pasted on each module as illustration, and its definitions are as following explanation.



(a) Model Name: N156B3 - L0B

(b) Revision: Rev. XX, for example: C1, C2 ...etc.

(c) Serial ID: XXXXXXYMDLNNNN



(d) Production Location: MADE IN XXXX. XXXX stands for production location.

(e) UL logo: "AAAA" especially stands for panel manufactured by CMO China satisfying UL requirement.

"LEOO" and "COCKN" is the CMO's UL factory code for Ningbo factory..

Serial ID includes the information as below:

(a) Manufactured Date: Year: 1~9, for 2001~2009

Month: 1~9, A~C, for Jan. ~ Dec.

Day: 1~9, A~Y, for 1<sup>st</sup> to 31<sup>st</sup>, exclude I, O and U

(b) Revision Code: cover all the change

(c) Serial No.: Manufacturing sequence of product

(d) Product Line: 1 -> Line1, 2 -> Line 2, ...etc.

(e) Revision Code: cover all the change

(f) Serial No.: Manufacturing sequence of production



## CT Label

|             |                                      |
|-------------|--------------------------------------|
| <b>S/N</b>  | <b>CT: CAYATXXVRXXXXX</b>            |
| <b>CT:</b>  | Title                                |
| <b>C</b>    | LCD Display Module                   |
| <b>AYAT</b> | Assembly Code                        |
| <b>XX</b>   | Revision                             |
| <b>VR</b>   | Supplier /Site of MFG                |
| <b>XX</b>   | Week/Year of MFG                     |
| <b>XXX</b>  | Serial number. From 000000 to 999999 |



## 10.2 CARTON LABEL


PO.NO. \_\_\_\_\_

Part ID. \_\_\_\_\_

Model Name N156B3-L0B

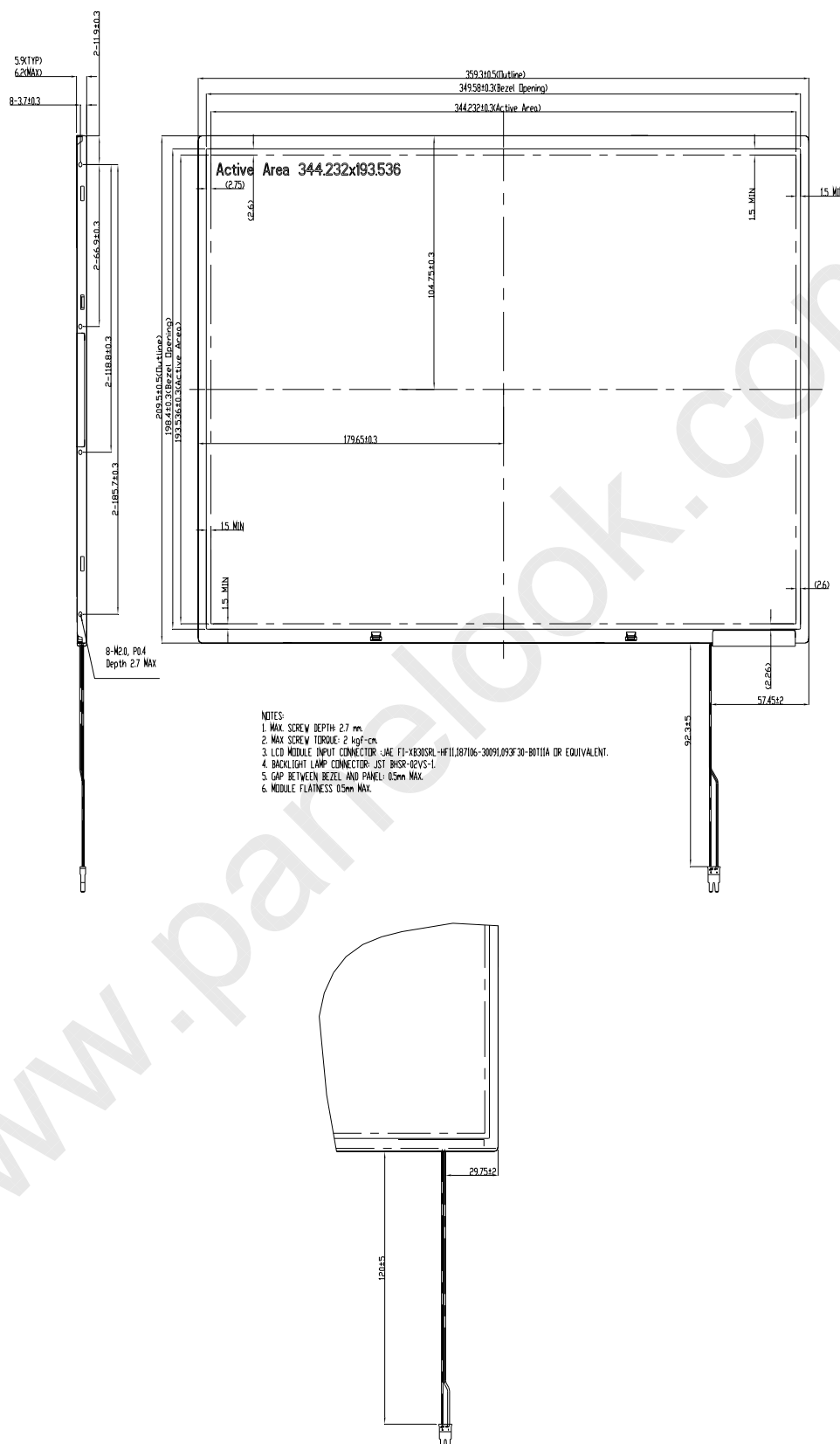
Carton ID. \_\_\_\_\_ Quantities 20

Made in XXXX

 GP  
RoHS

Model No.: N156B3-L0B

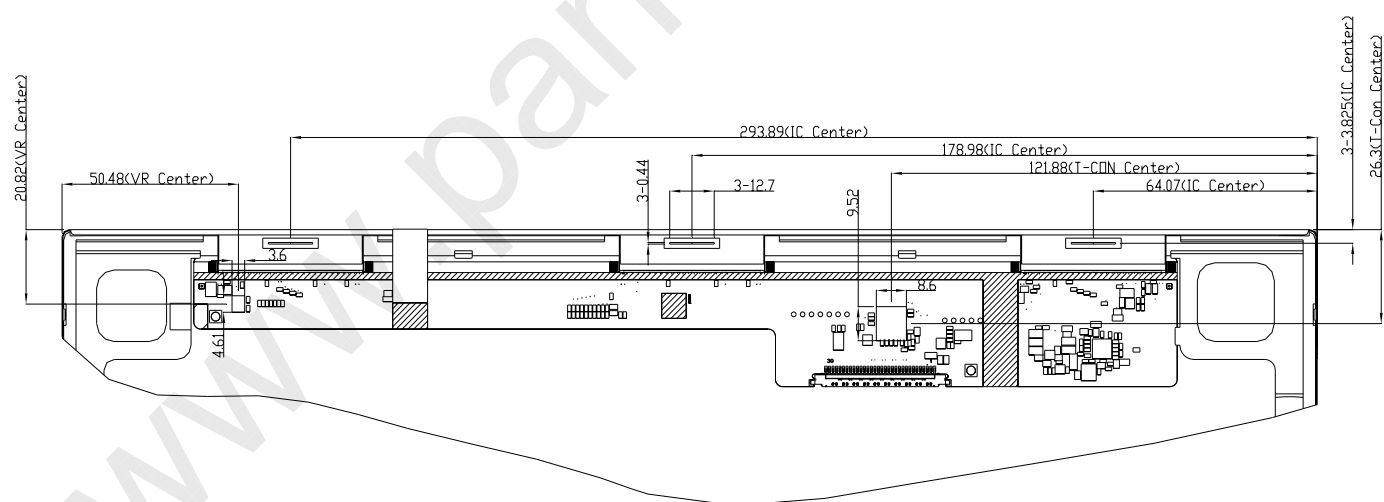
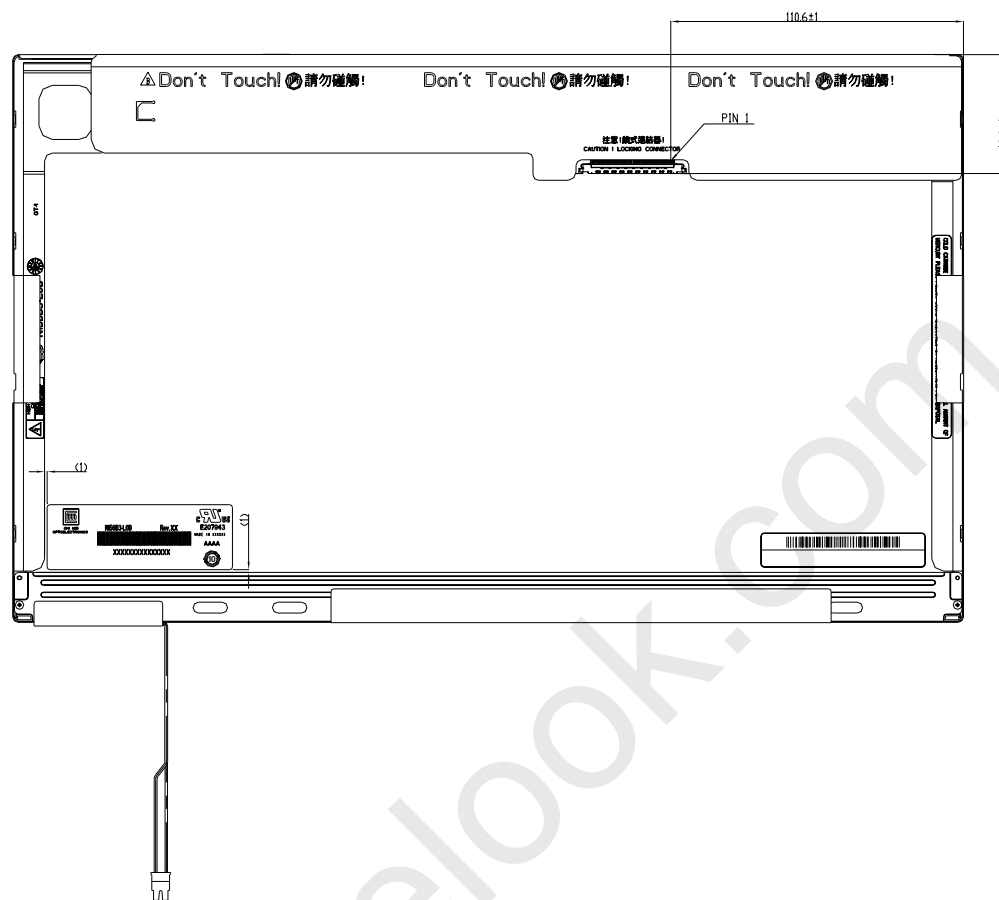
## Appendix. OUTLINE DRAWING





Issued Date: May. 27, 2010

Model No.: N156B3-L0B

**Approval**

## NOTES:

1. IN ORDER TO AVOID ABNORMAL DISPLAY, POOLING AND WHITE SPOT, NO OVERLAPPING IS SUGGESTED AT CABLES, ANTENNAS, CAMERA, WLAN, WAM OR OTHER FOREIGN OBJECTS OVER TCON AND VR LOCATION.